

**MODELING ANALYSES FOR  
SO<sub>2</sub> NAAQS COMPLIANCE  
FOR WARREN GENERATING STATION**

**OPERATED BY: THE PENNSYLVANIA ELECTRIC COMPANY**

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## **EXECUTIVE SUMMARY**

This document describes a dispersion modeling study that has been performed to demonstrate compliance with the sulfur dioxide (SO<sub>2</sub>) National Ambient Air Quality Standards (NAAQS) in the vicinity of the Pennsylvania Electric Company's (Penelec's) Warren Generating Station in northwestern Pennsylvania. This report represents the final product of a series of studies conducted to identify appropriate models and establish cost-effective emission limits that will achieve compliance with the SO<sub>2</sub> NAAQS.

The models used in the compliance analyses included the Large Area Power Plant Effluent Study (LAPPES) model, the Rough Terrain Diffusion Model (RTDM), and the Multiple Point with Terrain (MPTE) model. Regulatory approval to use LAPPES was obtained as a result of a model performance comparison study (TRC, 1994a) which showed that LAPPES is the superior model for determining air quality impacts from Warren Station in terrain above stack top, the "controlling" impacts for determining compliance emission rates.

The compliance modeling analyses described herein were performed in accordance with the "Modeling Protocol for SO<sub>2</sub> NAAQS Compliance Analyses for Warren Generating Station" (TRC, 1994b), the contents of which are summarized in this report. The compliance modeling results and a proposed set of compliance emission limits for operating Warren Station on two units combined and one unit alone are also presented herein.

## TABLE OF CONTENTS

<u>SECTION</u>	<u>PAGE</u>
EXECUTIVE SUMMARY . . . . .	ES-1
1.0 INTRODUCTION . . . . .	1
2.0 COMPLIANCE MODELING PROCEDURES . . . . .	3
2.1 Source Data . . . . .	5
2.2 Receptor Grid . . . . .	7
2.3 Meteorological Data . . . . .	7
2.4 Background Concentrations . . . . .	7
3.0 COMPLIANCE ANALYSIS RESULTS . . . . .	12
3.1 Compliance Emission Rate for Two Unit Operation . . . . .	12
3.2 Compliance Emission Rate for One Unit Operation . . . . .	19
4.0 REFERENCES . . . . .	25

## APPENDIX

### RECEPTOR COORDINATES FOR WARREN STATION COMPLIANCE

## LIST OF TABLES

<u>TABLE</u>		<u>PAGE</u>
2-1	Source Characteristics for Warren Station . . . . .	6
2-2	Stack Parameters for the United Refining Sources . . . . .	8
3-1	3-Hour Average SO <sub>2</sub> Concentrations that Exceed the NAAQS When both Warren Station Units are in Operation at 4.0 lbs/MMBtu . . . . .	13
3-2	24-Hour Average SO <sub>2</sub> Concentrations that Exceed the NAAQS When both Warren Station Units are in Operation at 4.0 lbs/MMBtu . . . . .	14
3-3	Annual Average SO <sub>2</sub> Concentrations that Exceed the NAAQS When both Warren Station Units are in Operation at 4.0 lbs/MMBtu . . . . .	16
3-4	Source Impacts Prior to Reduction (both Warren Station Units Operating) . . . . .	17
3-5	Source Impacts After Reduction (both Warren Station Units Operating) . . . . .	18
3-6	3-Hour Average SO <sub>2</sub> Concentrations that Exceed the NAAQS When Only Warren Station Unit 1 is in Operation at 4.0 lbs/MMBtu . . . . .	20
3-7	24-Hour Average SO <sub>2</sub> Concentrations that Exceed the NAAQS When Only Warren Station Unit 1 is in Operation at 4.0 lbs/MMBtu . . . . .	21
3-8	Annual Average SO <sub>2</sub> Concentrations that Exceed the NAAQS When Only Warren Station Unit 1 is in Operation at 4.0 lbs/MMBtu . . . . .	22
3-9	Source Impacts Prior to Reduction (Warren Station Unit 1 or 2 Operating) . . . . .	23
3-10	Source Impacts After Reduction (Warren Station Unit 1 or 2 Operating) . . . . .	24

## LIST OF FIGURES

<u>FIGURE</u>		<u>PAGE</u>
2-1	Study Region and Regional Terrain for Compliance Modeling . . . . .	4
2-2	Receptor Array for Terrain North of Warren Station . . . . .	9
2-3	Receptor Array for Terrain South of Warren Station . . . . .	10

## 1.0 INTRODUCTION

The Pennsylvania Electric Company (Penelec) operates the Warren Generating Station which is located in a region of complex terrain in northwest Pennsylvania. The region is presently designated non-attainment for sulfur dioxide (SO<sub>2</sub>) air quality, being originally designated as such on December 5, 1977. With regard to Warren Station, air quality impacts at high terrain locations are the primary concern.

Because of the area's non-attainment status, a dispersion modeling analysis is required to determine emission limits for Warren Station that will ensure National Ambient Air Quality Standards (NAAQS) attainment for the region. As a result of this modeling requirement, Penelec and the Pennsylvania Department of Environmental Resources (PaDER) entered into a Consent Order and Agreement (COA). The COA provides for a model evaluation study, interim emission limits, and a compliance schedule.

In the absence of an approved alternative, EPA guidance would require the use of two models to determine air quality impacts in the region: MPTEP (EPA, 1980) for simple and intermediate terrain, and RTDM (ERT, 1987) for intermediate and complex terrain. As an alternative, Penelec proposed the LAPPES model which was developed from a field program conducted from 1967 to 1972 in the Laurel/Chestnut Ridge region of Pennsylvania. Previous studies at other locations have shown that RTDM overpredicted at elevated terrain locations by more than a factor of two. In contrast, LAPPES has not shown such prediction bias in elevated terrain and is the preferred model from Penelec's standpoint.

A model performance comparison study was carried out to gain regulatory approval to use LAPPES instead of RTDM to set emission limits for Warren Station. EPA's "Interim Procedures" document (EPA, 1984) was followed to develop a study protocol and culminated in a model comparison report which showed the LAPPES model to be superior to RTDM/MPTEP for determining air quality impacts at elevated locations in the vicinity of Warren Station (TRC, 1994a). PaDER acceptance of the model comparison study report was received on August 25, 1994 (Slade, 1994).

In the model comparison study, it was found that a large percentage of the peak SO<sub>2</sub> concentrations measured by the Warren Station monitoring network was primarily attributable to an oil refinery, United Refining, and not Warren Station. In order to use the database to

objectively assess model performance, that source's contributions were effectively eliminated by an objective procedure. This allowed the emission reduction strategy to be developed and applied to Warren Station without undue penalty. Procedures developed by TRC for the model performance evaluation study and a later, independent study conducted by PaDER (Higgins, 1994) produced similar conclusions and were used to remove excessive impacts attributable to United Refining from the database.

The RTDM, LAPPES, and MPTEP models were used in accordance with procedures, described in detail in the compliance modeling protocol (TRC, 1994b), to determine new SO<sub>2</sub> emission limits for the Warren Station. The results presented herein were obtained by following the modeling methodology outlined in that protocol.

Section 2.0 summarizes the specific procedures that were followed by each model as it was applied to the emission source (Warren Station and United Refining) for which it was approved. The compliance modeling results and proposed emission rate limits are presented in Section 3.0. References are provided in Section 4.0.

## 2.0 COMPLIANCE MODELING PROCEDURES

The locations of Warren Station and the regional terrain are shown in Figure 2-1. The terrain in the region surrounding Warren Station ranges in elevation from 1150 feet above mean sea level (msl) in the river valley to 1960 feet on the terrain north and south of the plant. The region for which Penelec has used LAPPES in place of RTDM/MPTER is the elevated terrain (above stack top) in the immediate vicinity of Warren Station. This region (hereinafter called the "study region") is illustrated in Figure 2-1 by the heavy line. Also shown in the figure is the location of the only other significant SO<sub>2</sub> source, United Refining (cross-hatched area just east of the study region).

The following dispersion models were used to assess SO<sub>2</sub> impacts from Warren Station and United Refining.

SO <sub>2</sub> Source	Dispersion Model		
	Complex Terrain		Simple Terrain
	Above Plume Height	Intermediate	
Warren Station	LAPPES	LAPPES	MPTER
United Refining	RTDM	RTDM/MPTER	MPTER

For Warren Station, the LAPPES model was used to predict concentrations in complex terrain (i.e., above stack top) only at receptors located within the study region (Figure 2-1). The MPTER model was used to predict concentrations in simple terrain (i.e., below stack top). The LAPPES model was also used to predict concentrations in intermediate terrain (i.e., at receptors with elevations between stack top and plume height) inside the study region. For United Refining at all receptors, the RTDM, RTDM/MPTER and MPTER models were used to predict concentrations in above-plume-height, intermediate, and simple terrain, respectively. These models were described in the protocol for the model performance evaluation study (TRC, 1992), and the model descriptions therein are incorporated into this document by reference. For these compliance analyses, modeling was not performed for receptors outside the study region.



The concentration predictions from the models were adjusted for background concentrations and compared to the NAAQS for SO<sub>2</sub>:

NAAQS		Background Concentrations
Averaging Time	Concentrations (μg/m <sup>3</sup> )	
3-hour	1300*	See Section 2.4
24-hour	365*	
Annual	80	

\* High second high values

Except for a relatively minor modification of the monitored SO<sub>2</sub> database (TRC, 1994b), the meteorological data, monitored SO<sub>2</sub> data, and modeling procedures were the same as those used in the model performance evaluation study. The exceptions for the compliance analyses were that specific identified hours were deleted from the SO<sub>2</sub> database as a result of PaDER's study of United Refining's impacts. These deletions affected the background concentration values since the SO<sub>2</sub> data for those hours were eliminated.

## 2.1 Source Data

Warren Station was modeled at 100 percent load for two compliance scenarios. Specifically, operation of both Units 1 and 2 combined and Unit 1 or 2 alone were modeled to determine appropriate emission limits.

Emissions from the only other major SO<sub>2</sub> source in the area, United Refining, were also modeled, and impacts added to those of Warren Station.

The SO<sub>2</sub> emission factors and stack parameters corresponding to 100 percent load conditions for Warren Station are given in Table 2-1. Previous modeling analyses with RTDM and LAPPES have shown that locations of peak concentrations are insensitive to load and that full load conditions produce "controlling" concentrations. Partial load cases were, therefore, not modeled.

There are 13 point sources of SO<sub>2</sub> located at United Refining. These were modeled and their impacts added to the modeled impacts from Warren Station. The stack parameter data

TABLE 2-1  
SOURCE CHARACTERISTICS FOR WARREN STATION

	Units 1 and 2 (Full Station Output)	Unit 1 or 2 Alone (½ Station Output)
Generator Capacity	94 MW	47.0 MW
Full Load Heat Rate (MMBtu/MWH)	12.66	12.66
Base Case SO <sub>2</sub> Emission Factor	4.0 lb/MMBtu	4.0 lb/MMBtu
SO <sub>2</sub> Emission Rate based on 4.0 lb/MMBtu	600 g/s	300 g/s
SO <sub>2</sub> Emission Factor Limit	3.32 lb/MMBtu	3.47 lb/MMBtu
SO <sub>2</sub> Emission Rate	498 g/s	260 g/s
Stack Temperature	481 K <sup>(1)</sup>	474 K <sup>(2)</sup>
Stack Exit Velocity	13.5 m/s <sup>(1)</sup>	7.7 m/s <sup>(2)</sup>
UTM East Coordinate (km)	650.39	650.39
UTM North Coordinate (km)	4632.95	4632.95
Source Base Elevation (ft MSL)	1186	1186
Stack Height	61.0 m	61.0 m
Stack Diameter	4.72 m	4.72 m

(1) April 1994 revisions based on CEM data

(2) August 1994 based on CEM certification testing

for sources located at United Refining appear in Table 2-2. The values in Table 2-2 were the same as those used in previous modeling conducted in the model performance evaluation.

The stack parameters and emission rates shown in Tables 2-1 and 2-2 constitute the "base case" conditions for the compliance modeling. The compliance emission rates for Warren Station were determined by comparing modeled impacts to the NAAQS for SO<sub>2</sub> and, after accounting for background concentrations, making adjustments to the base case emission rate to satisfy the NAAQS for SO<sub>2</sub>.

## 2.2 Receptor Grid

The modeling region extends approximately 10 km north and south of Warren Station, 5 km to the east and 10 km to the west. A total of 417 receptors were used and concentrated on terrain within 5 km north and south of the Station. The receptor grid is that developed in previous modeling exercises, particularly from the SO<sub>2</sub> monitoring site design study for Warren Station (TRC, 1991). This ensured that concentration predictions were made at points of previously modeled maximum concentrations.

To the north of Warren Station, 168 receptors were placed at elevated locations, mainly above 1600 feet (Figure 2-2). One hundred twenty-three (123) receptors cover elevated terrain within about 3 km of Warren Station. An array of 249 receptors was placed to the south of Warren Station ranging in elevation from 1,400 to 1,920 feet (Figure 2-3). Most are located within 4 km of Warren Station.

The Appendix lists all receptors, their UTM coordinates, and elevations.

## 2.3 Meteorological Data

The meteorological input data were the same as those used for the model comparison study, i.e., measurements from the two on-site meteorological towers at Conewango and Preston developed for the one-year period from March 1, 1993 through February 28, 1994.

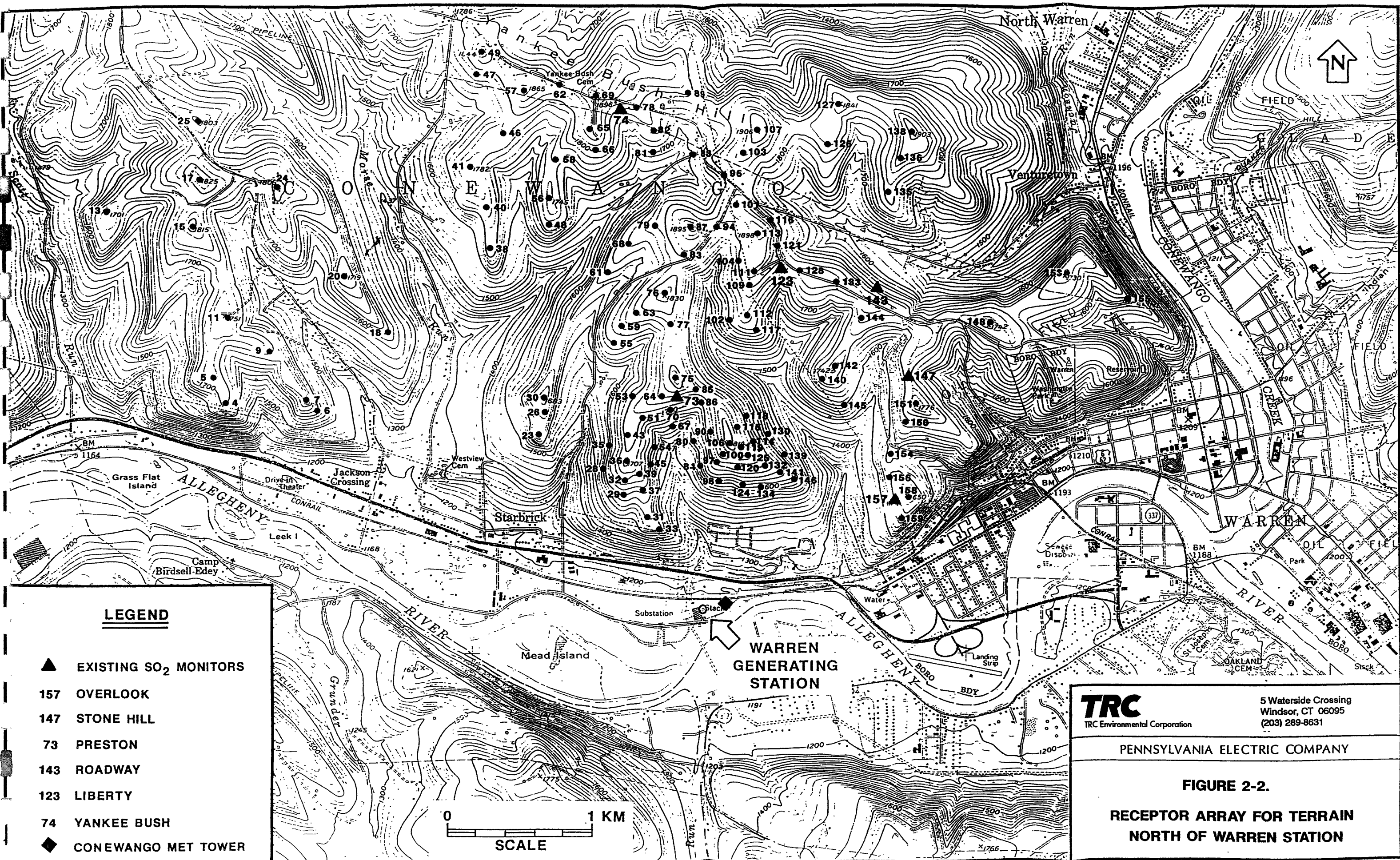
## 2.4 Background Concentrations

Background concentrations represent contributions from remote or unidentified sources that were not explicitly modeled in the compliance evaluation. These were determined

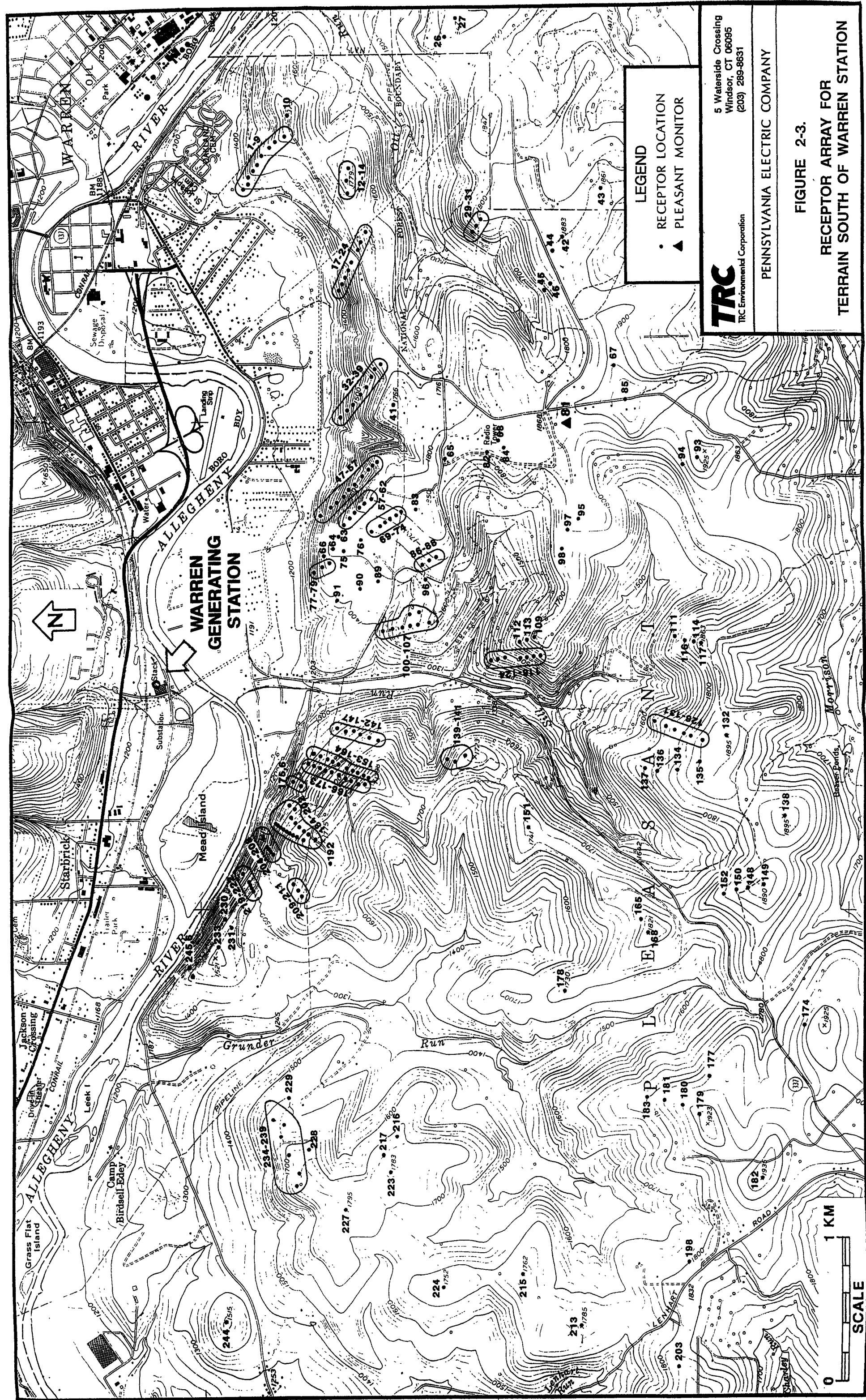
TABLE 2-2

## STACK PARAMETERS FOR THE UNITED REFINING SOURCES

Source	SO <sub>2</sub> Emission Rate (g/s)	UTM East (km)	UTM North (km)	Base Elevation (ft)	Stack Height (m)	Stack Diameter (m)	Stack Temperature (K)	Exit Velocity (m/s)
Boiler House	28.73	655,660	4632.170	1,195	68.58	2.44	672.0	11.44
No. 4 Boiler	1.64	655,461	4632.394	1,195	45.72	1.70	505.4	12.37
FCC Charge Heater	1.89	655,450	4632.392	1,195	38.10	1.22	560.9	10.51
DHT1 Heater	0.13	655,906	4632.024	1,195	30.48	0.91	922.0	3.88
Prefrac Reboiler (East)	0.44	655,865	4632.055	1,195	12.19	0.61	699.8	10.03
Prefrac Reboiler (West)	0.44	655,860	4632.052	1,195	12.19	0.61	699.8	10.03
Old Reformer Heater	8.44	655,911	4632.022	1,195	45.72	1.89	699.8	10.43
Crude Heater	32.51	655,814	4632.110	1,195	45.72	2.59	699.8	15.09
Pretreater Heater	1.76	655,894	4632.129	1,195	51.82	1.89	588.7	3.84
New Reformer Heater	1.13	655,901	4632.028	1,195	45.72	2.13	533.2	6.65
Debut Reboiler	0.25	655,826	4632.095	1,195	30.48	0.85	922.0	12.70
FCC Regenerator	42.46	655,494	4632.454	1,195	45.72	2.13	533.2	15.21
No. 5 Boiler	<u>0.25</u>	655,887	4632.056	1,195	30.48	1.22	588.7	12.05
Total	120.07							



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<b>FIGURE 2-2.</b> <b>RECEPTOR ARRAY FOR TERRAIN</b> <b>NORTH OF WARREN STATION</b>	



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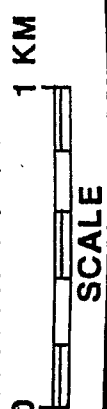
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FIGURE 2-3.

RECEPTOR ARRAY FOR  
TERRAIN SOUTH OF WARREN STATION

LEGEND

- RECEPTOR LOCATION
- ▲ PLEASANT MONITOR



using the full year of monitored data collected from all seven monitors for the model evaluation study.

For the compliance modeling, the background concentration was varied hourly, depending on the value of the lowest concentration monitored for each hour. However, the background concentration for the hours identified by PaDER as having been impacted by United Refining (Higgins, 1994) were calculated differently. The background concentration for each of those hours was determined as the average of the background concentration values calculated for the remaining hours of measured SO<sub>2</sub> data.

### 3.0 COMPLIANCE ANALYSIS RESULTS

The required models were run in accordance with the specific procedures discussed above to determine compliance emission rates for Warren Station.

SO<sub>2</sub> concentrations were predicted over the entire receptor network, including receptors in complex terrain (i.e., above plume height), intermediate terrain and simple terrain within the study area (see Figures 2-1, 2-2, and 2-3). The averaging times were those of the NAAQS for SO<sub>2</sub>, i.e., 3-hour, 24-hour, and annual.

The sources modeled were Warren Station in two configurations and United Refining with 13 sources. The stack parameters for these sources are shown in Tables 2-1 and 2-2, respectively.

Two modeling runs were conducted, one with both units at Warren Station operating, and the other with only one unit operating (see Table 2-1). All 13 of United Refining's sources operated at their baseline emission rates for both runs. The maximum predicted concentrations occurred in complex terrain within the study area for both operating configurations.

#### 3.1 Compliance Emission Rate for Two Unit Operation

Table 3-1 shows the 3-hour average modeled concentrations that exceed the NAAQS when both Warren Station units are in operation at 4.0 lb/MMBtu. Also shown are the receptors at which the exceedances occurred, contributions from Warren Station, United Refining and background, and the exceedance of the NAAQS in percent. The highest second high concentration (H2H) (1,435  $\mu\text{g}/\text{m}^3$ ) occurred at receptor 173 (Receptor #9 in Figure 2-3), which is located in the eastern portion of the study region at an elevation of 1,720 feet. It is located approximately 1 km southwest of United Refining and 3 km east southeast of Warren Station. The impact from United Refining (1,086  $\mu\text{g}/\text{m}^3$ ) dominates.

Table 3-2 is a similar table for the 24-hour average concentrations. The H2H concentration (432  $\mu\text{g}/\text{m}^3$ ) occurred at receptor 151 (Figure 2-2), also located in the eastern portion of the study area at an elevation of 1,776 feet. It is located approximately 3 km northwest of United Refining and 2 km northeast of Warren Station. In this case, the impact from Warren Station (390  $\mu\text{g}/\text{m}^3$ ) dominates.

Table 3-1

3-Hour Average SO<sub>2</sub> Concentrations that Exceed the NAAQS  
When both Warren Station Units are in  
Operation at 4.0 lbs/MMBtu

Rec	Dy	Hr	Warren	United	Bkg	Total	Percent Over
133	109	6	1355	0	28.7	1384	6.5
135	109	6	1311	0	28.7	1340	3.1
136	109	6	1287	0	28.7	1316	1.2
147	326	9	1252	0	53.0	1305	0.4
148	326	3	1259	0	65.0	1324	1.8
149	326	3	1324	0	65.0	1389	6.8
151	326	3	1299	0	65.0	1364	4.9
169	85	6	0.0	1401	11.0	1412	8.6
169	279	6	0.0	1383	14.0	1397	7.4
170	85	6	0.0	1535	11.0	1546	19.0
170	230	6	83.1	1314	0.0	1397	7.5
170	351	6	0.0	1329	1.7	1331	2.4
171	85	6	0.0	1383	11.0	1394	7.2
172	230	6	100	1369	0.0	1469	13.0
172	281	6	0.0	1383	9.0	1392	7.1
172	192	3	323	1064	0.0	1387	6.7
172	351	6	0.0	1366	1.7	1368	5.2
172	85	6	0.0	1336	11.0	1347	3.6
173	230	6	106	1399	0.0	1505	15.8
173	192	3	349	1086	0.0	1435	10.4
173	281	6	0.0	1421	9.0	1430	10.0
173	351	6	0.0	1408	1.7	1410	8.5
173	85	6	0.0	1358	11.0	1369	5.3
173	268	3	0.0	1339	11.7	1351	3.9
173	251	6	0.0	1300	16.3	1316	1.3
174	268	3	0.0	1469	11.7	1481	13.9
174	190	6	0.0	1335	8.7	1344	3.4
174	12	6	0.0	1295	14.3	1309	0.7
174	131	6	0.0	1295	12.0	1307	0.5
176	251	6	0.0	1328	16.3	1345	3.4
177	251	6	0.0	1348	16.3	1365	5.0

High Second High for that particular receptor

Table 3-2

24-Hour Average SO<sub>2</sub> Concentrations that Exceed the NAAQS  
When both Warren Station Units are in  
Operation at 4.0 lbs/MMBtu

Rec	Dy	Hr	Warren	United	Bkg	Total	Percent Over
147	326	24	484	0	37.5	522	42.9
147	19	24	364	0	19.4	383	5.1
148	326	24	530	0	37.5	567	55.4
149	326	24	562	0	37.5	599	64.1
149	352	24	385	6.11	35.6	426	16.8
149	19	24	396	0	19.4	415	13.8
149	315	24	357	0	48.0	405	10.9
149	1	24	317	0	63.6	381	4.3
149	32	24	350	0	20.2	370	1.5
150	326	24	526	0	37.5	564	54.5
150	315	24	330	0	48.0	378	3.6
150	352	24	326	13.4	35.6	375	2.7
151	326	24	531	0	37.5	569	55.8
151	352	24	390	5.79	35.6	432	18.3
151	315	24	356	0	48.0	404	10.8
151	19	24	378	0	19.4	397	8.8
151	1	24	326	0	63.6	389	6.7
151	32	24	357	0	20.2	377	3.4
152	326	24	411	0	37.5	449	23.0
152	352	24	332	1.51	35.6	369	1.1
153	326	24	392	0	37.5	429	17.6
153	352	24	333	1.52	35.6	370	1.5
158	297	24	389	0.189	49.2	439	20.2
159	297	24	352	0.346	49.2	401	9.9
169	85	24	0.0	504	12.7	517	41.6
170	85	24	0.0	554	12.7	567	55.3
171	85	24	0.0	455	12.7	467	28.0
172	85	24	0.0	550	12.7	563	54.1
172	86	24	0.0	376	6.88	383	4.9
173	85	24	0.0	571	12.7	583	59.8
173	227	24	24.8	368	18.7	412	12.7
173	86	24	0.0	385	6.9	392	7.4
174	227	24	24.3	384	18.7	427	17.1
174	85	24	0.0	414	12.7	427	16.9
328	250	24	349	25.3	1.08	375	2.7
381	241	24	335	43.1	5.7	384	5.2
387	347	24	382	13.2	11.0	406	11.3
387	241	24	338	42.1	5.7	385	5.6
401	85	24	283	74.3	12.7	370	1.4
402	85	24	297	71.8	12.7	382	4.6
403	85	24	300	72.4	12.7	385	5.5

High Second High for that particular receptor

Table 3-3 shows the modeled annual average concentrations that exceed the NAAQS. The maximum concentration occurs at receptor 174 (Receptor #10) at an elevation of 1,751 feet, located approximately 1 km southwest of United Refining and approximately 3 km east southeast of Warren Station. The impact from United Refining dominates.

Table 3-4 summarizes the H<sub>2</sub>H SO<sub>2</sub> concentrations for the 3-hour, 24-hour, and annual averaging times for a two unit operation. Also shown in the table is the percent reduction in emissions that is required to achieve compliance. The required reductions show that the 24-hour average impact is controlling.

The proposed SO<sub>2</sub> emission reduction strategy to achieve NAAQS compliance for Warren Station is predicated on the basis that both Warren Station and United Refining will be subject to the same percent reduction in emissions that is required to achieve overall NAAQS compliance. Proceeding on this basis, the percent reductions in SO<sub>2</sub> emission rates for Warren Station are:

For the 3-hour averaging time:

The emission reduction required is 9.4 percent. Therefore, the required emission limit to achieve the 3-hour NAAQS =  $0.906 (4.0 \text{ lb/MMBtu}) = 3.62 \text{ lb/MMBtu}$ .

For the 24-hour averaging time:

The emission reduction required is 17 percent. Therefore, the required emission limit to achieve the 24-hour NAAQS =  $0.83 (4.0 \text{ lb/MMBtu}) = 3.32 \text{ lb/MMBtu}$ .

For the annual averaging time:

The emission reduction required is 15.5 percent. Therefore, the required emission limit to achieve the annual NAAQS =  $0.845 (4.0 \text{ lb/MMBtu}) = 3.38 \text{ lb/MMBtu}$ .

The controlling emission limit is that which is most stringent to achieve an individual NAAQS. In this analysis, this emission limit is that which is required to achieve the 24-hour NAAQS, 3.32 lb/MMBtu. As shown in Table 3-5, applying this emission limit to all averaging times produces NAAQS compliance for all averaging times. Penelec, therefore, offers 3.32 lb SO<sub>2</sub>/MMBtu as the compliance emission limit for the operation of both units at Warren Station.

Table 3-3

Annual Average SO<sub>2</sub> Concentrations that Exceed the NAAQS  
When both Warren Station Units are in  
Operation at 4.0 lbs/MMBtu

Rec	Dy	Hr	Warren	United	Bkg	Total	Percent Over
170	n/a	n/a	26.72	45.71	9.74	82.17	2.7
172	n/a	n/a	27.62	49.54	9.75	86.91	8.6
173	n/a	n/a	29.08	51.78	9.74	90.60	13.3
174	n/a	n/a	28.78	54.4	9.74	92.92	16.1

TABLE 3-4

SOURCE IMPACTS PRIOR TO REDUCTION  
(BOTH WARREN STATION UNITS OPERATING)

Averaging Period	Warren @ 4.0 lb/MMBtu ( $\mu\text{g}/\text{m}^3$ )	United Refining ( $\mu\text{g}/\text{m}^3$ )	Background ( $\mu\text{g}/\text{m}^3$ )	Total ( $\mu\text{g}/\text{m}^3$ )	NAAQS ( $\text{SO}_2/\mu\text{g}/\text{m}^3$ )	Percent Reduction Required
3-Hour	348.64	1,086.33	0.0	1,434.96	1,300	9.4
24-Hour	390.25	5.79	36.03	432.07	365	17.0
Annual	28.8	54.4	9.74	92.9	80	15.5

TABLE 3-5

SOURCE IMPACTS AFTER REDUCTION  
(BOTH WARREN STATION UNITS OPERATING)

Averaging Period	Warren @ 3.32 lb/MMBtu ( $\mu\text{g}/\text{m}^3$ )	United Refining ( $\mu\text{g}/\text{m}^3$ )	Background ( $\mu\text{g}/\text{m}^3$ )	Total ( $\mu\text{g}/\text{m}^3$ )	NAAQS ( $\text{SO}_2/\mu\text{g}/\text{m}^3$ )
3-Hour	289	902	0.0	1,191	1,300
24-Hour	324	4.81	36.0	364.8	365
Annual	23.9	45.2	9.74	78.8	80

### 3.2 Compliance Emission Rate for One Unit Operation

Tables 3-6 through 3-8 show analogous information as that shown in Tables 3-1 through 3-3 except that only one unit at Warren Station is operating at 4.0 lb/MMBtu. The highest impacts associated with one unit operating are lower than those when both units are operating.

Table 3-9 summarizes the H<sub>2</sub>H SO<sub>2</sub> concentrations for 3-hour, 24-hour, and annual averaging times for a one unit operation. Also shown in the table is the percent reduction in emissions that is required to achieve compliance. The required reductions show that the 24-hour average impact is controlling, the same as in the two unit operation. Proceeding on the same basis as with the two unit operation, the percent reductions in SO<sub>2</sub> emission rates for Warren Station for one unit operating are:

For the 3-hour averaging time:

The emission reduction required is 9.2 percent. Although Warren Station's impact is zero at the H<sub>2</sub>H receptor, application of a 9.2 percent reduction to both sources will ensure compliance at all receptors. Therefore, the required emission limit to achieve the 3-hour NAAQS =  $0.908 (4.0 \text{ lb/MMBtu}) = 3.63 \text{ lb/MMBtu}$ .

For the 24-hour averaging time:

The emission reduction required is 13.3 percent. Therefore, the required emission limit to achieve the 24-hour NAAQS =  $0.867 (4.0 \text{ lb/MMBtu}) = 3.47 \text{ lb/MMBtu}$ .

For the annual averaging time:

The emission reduction required is 7.6 percent. Therefore, the required emission limit to achieve the annual NAAQS =  $0.924 (4.0 \text{ lb/MMBtu}) = 3.69 \text{ lb/MMBtu}$ .

The controlling emission limit is that which is most stringent to achieve an individual NAAQS. In this analysis, for a one unit operation the controlling emission limit is that which is required to achieve the 24-hour NAAQS, or 3.47 lb/MMBtu. As shown in Table 3-10, applying this emission limit to all averaging times produces NAAQS compliance for all averaging times. Penelec offers 3.47 lb/MMBtu as the compliance emission limit for a one unit operation.

Table 3-6

3-Hour Average SO<sub>2</sub> Concentrations that Exceed the NAAQS  
When only Warren Station Unit 1 is in  
Operation at 4.0 lbs/MMBtu

Rec	Dy	Hr	Warren	United	Bkg	Total	Percent Over
169	85	6	0	1400.775	11	1412	8.6
169	279	6	0	1382.658	14	1397	7.4
170	85	6	0	1535.373	11	1546	19.0
170	230	6	41.905	1314.286	0	1356	4.3
170	351	6	0	1329.426	1.667	1331	2.4
171	85	6	0	1383.246	11	1394	7.2
172	230	6	53.741	1369.218	0	1423	9.5
172	281	6	0	1383.455	9	1392	7.1
172	351	6	0	1366.497	1.667	1368	5.2
172	85	6	0	1335.623	11	1347	3.6
172	192	3	272.456	1063.933	0	1336	2.8
173	230	6	56.652	1399.253	0	1456	12.0
173	281	6	0	1421.031	9	1430	10.0
173	351	6	0	1408.448	1.667	1410	8.5
173	192	3	293.35	1086.326	0	1380	6.1
173	85	6	0	1358.143	11	1369	5.3
173	268	3	0	1339.151	11.667	1351	3.9
173	251	6	0	1300.042	16.333	1316	1.3
174	268	3	0	1469.368	11.667	1481	13.9
174	190	6	0	1335.431	8.667	1344	3.4
174	12	6	0	1295.11	14.333	1309	0.7
174	131	6	0	1294.911	12	1307	0.5
176	251	6	0	1328.478	16.333	1345	3.4
177	251	6	0	1348.217	16.333	1365	5.0

High Second High for that particular receptor

Table 3-7

24-Hour Average SO<sub>2</sub> Concentrations that Exceed the NAAQS  
When only Warren Station Unit 1 is in  
Operation at 4.0 lbs/MMBtu

Rec	Dy	Hr	Warren	United	Bkg	Total	Percent Over
149	326	24	383.123	0	37.5	421	15.2
150	326	24	380.247	0	37.5	418	14.5
158	297	24	319.412	0.189	49.208	369	1.0
169	85	24	0	504.291	12.708	517	41.6
170	85	24	0	554.14	12.708	567	55.3
171	85	24	0	454.582	12.708	467	28.0
172	85	24	0	549.907	12.708	563	54.1
172	86	24	0	376.143	6.875	383	4.9
173	85	24	0	570.715	12.708	583	59.8
173	227	24	15.089	367.956	18.708	402	10.1
173	86	24	0	385.044	6.875	392	7.4
174	85	24	0	413.975	12.708	427	16.9
174	227	24	14.653	384.381	18.708	418	14.4

High Second High for that particular receptor

Table 3-8

Annual Average SO<sub>2</sub> Concentrations that Exceed the NAAQS  
When only Warren Station Unit 1 is in  
Operation at 4.0 lbs/MMBtu

Rec	Dy	Hr	Warren	United	Bkg	Total	Percent Over
172	n/a	n/a	21.16	49.54	9.75	80.45	0.6
173	n/a	n/a	22.11	51.78	9.75	83.64	4.5
174	n/a	n/a	21.55	54.4	9.74	85.69	7.1

TABLE 3-9

SOURCE IMPACTS PRIOR TO REDUCTION  
(WARREN STATION UNIT 1 OR 2 OPERATING)

Averaging Period	Warren @ 4.0 lb/MMBtu ( $\mu\text{g}/\text{m}^3$ )	United Refining ( $\mu\text{g}/\text{m}^3$ )	Background ( $\mu\text{g}/\text{m}^3$ )	Total ( $\mu\text{g}/\text{m}^3$ )	NAAQS ( $\text{SO}_2/\mu\text{g}/\text{m}^3$ )	Percent Reduction Required
3-Hour	0.0	1,421	9.0	1,430	1,300	9.2
24-Hour	14.7	384.4	18.7	418.0	365	13.3
Annual	21.6	54.4	9.74	85.7	80	7.6

TABLE 3-10

SOURCE IMPACTS AFTER REDUCTION  
(WARREN STATION UNIT 1 OR 2 OPERATING)

Averaging Period	Warren @ 3.47 lb/MMBtu ( $\mu\text{g}/\text{m}^3$ )	United Refining ( $\mu\text{g}/\text{m}^3$ )	Background ( $\mu\text{g}/\text{m}^3$ )	Total ( $\mu\text{g}/\text{m}^3$ )	NAAQS ( $\text{SO}_2/\mu\text{g}/\text{m}^3$ )
3-Hour	0.0	1,232	9.0	1,241	1,300
24-Hour	12.74	333.3	18.7	364.7	365
Annual	18.73	47.16	9.74	75.6	80

#### **4.0 REFERENCES**

2. EPA, 1980, "User's Guide for MPTER - A Multiple Point Gaussian Dispersion Algorithm with Optional Terrain Adjustment," April 1980.
3. EPA, 1984, "Interim Procedures for Evaluating Air Quality Models (Revised)," 450/4-84-023, September 1984.
4. ERT, 1987, "User's Guide to the Rough Terrain Diffusion Model (RTDM) (Rev. 3.20)," Doc. #P-D535-585, July 1987.
5. Higgins, 1994, "Warren Generating Station Model Comparison Study," memo to James Salvaggio, PaDER, September 1994.
6. Slade, 1994, "Letter from John Slade, PaDER to Vincent Brisini, Penelec," August 1994.
7. TRC, 1991, "Monitoring Network Design Analysis Using Conewango Tower Data for Warren Model Performance Comparison," October 1991.
8. TRC, 1992, "Protocol for the Model Performance Comparison Study for Penelec's Warren Generating Station," September 1992.
9. TRC, 1994a, "Final Report on the Model Performance Comparison Study for Warren Generating Station," May 1994.
10. TRC, 1994b, "Modeling Protocol for SO<sub>2</sub> NAAQS Compliance Analyses for Warren Generating Station," October 1994.

## **APPENDIX**

### **RECEPTOR COORDINATES FOR WARREN STATION COMPLIANCE**

**Appendix**  
**Receptor Coordinates for**  
**Warren Station Compliance**

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
1	1	641.7	4635.1	1682
2	2	642.2	4635.4	1721
3	3	643.1	4635.9	1660
4	4	647.0	4634.4	1705
5	5	646.9	4634.6	1720
6	6	647.6	4634.3	1600
7	7	647.5	4634.4	1680
8	8	641.3	4637.8	1815
9	9	647.3	4634.7	1700
10	10	644.7	4636.3	1760
11	11	646.9	4635.0	1751
12	12	647.0	4635.0	1751
13	13	646.2	4635.7	1701
14	14	643.1	4637.7	1700
15	15	646.7	4635.6	1815
16	16	644.5	4637.4	1795
17	17	646.8	4636.0	1825
18	18	648.1	4634.9	1600
19	19	646.8	4636.0	1825
20	20	647.8	4635.3	1719
21	21	644.9	4637.9	1819
22	22	643.9	4638.8	1795
23	23	649.2	4634.1	1645
24	24	647.3	4635.9	1806
25	25	646.8	4636.4	1803
26	26	649.2	4634.3	1670
27	27	645.5	4638.8	1835
28	28	649.6	4633.9	1600
29	29	649.7	4633.7	1600
30	30	649.2	4634.4	1683
31	31	649.9	4633.6	1560
32	32	649.7	4633.8	1660
33	33	650.0	4633.5	1540
34	34	646.3	4639.0	1858
35	35	649.6	4634.1	1600
36	36	649.7	4634.0	1707
37	37	649.9	4633.8	1600
38	38	648.8	4635.5	1705
39	39	649.8	4633.9	1660
40	40	648.8	4635.8	1750

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
41	41	648.7	4636.1	1782
42	42	648.7	4636.1	1782
43	43	649.8	4634.1	1705
44	44	647.4	4639.1	1855
45	45	649.9	4634.0	1600
46	46	648.9	4636.3	1780
47	47	648.7	4636.7	1780
48	48	649.2	4635.6	1705
49	49	648.7	4636.9	1844
50	50	649.2	4635.8	1745
51	51	649.9	4634.3	1700
52	52	648.8	4636.9	1844
53	53	649.8	4634.4	1700
54	54	650.0	4634.1	1600
55	55	649.7	4634.8	1700
56	56	649.3	4635.8	1745
57	57	649.0	4636.6	1865
58	58	649.3	4636.1	1740
59	59	649.7	4634.9	1740
60	60	649.1	4636.6	1865
61	61	649.6	4635.3	1700
62	62	649.3	4636.7	1850
63	63	649.8	4635.0	1780
64	64	650.0	4634.4	1760
65	65	649.5	4636.4	1860
66	66	649.6	4636.2	1800
67	67	650.1	4634.2	1600
68	68	649.8	4635.5	1740
69	69	649.5	4636.6	1896
70	70	650.1	4634.3	1700
71	71	648.7	4640.2	1795
72	72	648.6	4640.8	1838
73	73	650.1	4634.5	1760
74	74	649.7	4636.5	1800
75	75	650.1	4634.6	1820
76	76	650.0	4635.2	1830
77	77	650.1	4635.0	1780
78	78	649.8	4636.5	1800
79	79	650.0	4635.7	1780
80	80	650.2	4634.1	1600

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
81	81	650.0	4636.2	1700
82	82	650.0	4636.4	1760
83	83	650.1	4635.5	1800
84	84	650.3	4634.0	1600
85	85	650.2	4634.5	1760
86	86	650.3	4634.4	1700
87	87	650.2	4635.7	1895
88	88	650.2	4636.2	1700
89	89	650.2	4636.6	1800
90	90	650.3	4634.2	1700
91	91	650.3	4636.8	1800
92	92	650.3	4640.5	1848
93	93	650.4	4636.8	1700
94	94	650.4	4635.7	1800
95	95	650.5	4639.4	1600
96	96	650.5	4636.0	1800
97	97	650.4	4634.0	1700
98	98	650.4	4633.8	1600
99	99	650.5	4636.8	1600
100	100	650.4	4634.0	1750
101	101	650.5	4635.8	1860
102	102	650.5	4635.0	1700
103	103	650.6	4636.2	1880
104	104	650.6	4635.4	1800
105	105	650.9	4640.0	1882
106	106	650.5	4634.1	1814
107	107	650.7	4636.4	1906
108	108	650.7	4636.4	1906
109	109	650.6	4635.2	1800
110	110	651.0	4639.1	1904
111	111	650.7	4635.3	1840
112	112	650.6	4635.0	1730
113	113	650.7	4635.6	1898
114	114	650.5	4634.1	1700
115	115	650.5	4634.2	1760
116	116	650.8	4635.7	1830
117	117	650.7	4634.9	1700
118	118	650.6	4634.3	1700
119	119	650.6	4634.1	1750
120	120	650.6	4633.9	1700

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
121	121	650.8	4635.5	1800
122	122	651.8	4640.7	1882
123	123	650.9	4635.4	1790
124	124	650.6	4633.8	1600
125	125	650.6	4634.0	1750
126	126	651.2	4636.3	1820
127	127	651.3	4636.6	1841
128	128	651.0	4635.4	1780
129	129	651.3	4636.5	1841
130	130	650.7	4634.2	1600
131	131	652.1	4638.6	1828
132	132	650.7	4634.0	1700
133	133	651.2	4635.3	1780
134	134	650.7	4633.8	1600
135	135	651.6	4635.9	1810
136	136	651.7	4636.2	1880
137	137	652.7	4638.4	1798
138	138	651.8	4636.3	1903
139	139	650.9	4634.0	1600
140	140	651.1	4634.6	1700
141	141	650.8	4633.9	1650
142	142	651.2	4634.6	1742
143	143	651.5	4635.3	1720
144	144	651.4	4635.0	1740
145	145	651.3	4634.4	1600
146	146	651.0	4633.8	1600
147	147	651.8	4634.6	1700
148	148	652.3	4635.0	1742
149	149	651.8	4634.4	1776
150	150	651.7	4634.3	1690
151	151	651.9	4634.4	1776
152	152	652.8	4635.3	1730
153	153	652.9	4635.4	1730
154	154	651.6	4634.1	1610
155	155	653.3	4635.4	1600
156	156	651.6	4633.9	1600
157	157	651.7	4633.8	1600
158	158	651.7	4633.7	1650
159	159	651.7	4633.6	1600
160	160	651.7	4633.6	1560

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
161	161	651.7	4633.6	1520
162	162	651.7	4633.5	1480
163	163	651.6	4633.5	1440
164	164	651.6	4633.5	1400
165	1	654.0	4632.3	1520
166	2	654.0	4632.3	1480
167	3	653.9	4632.3	1440
168	4	653.9	4632.3	1400
169	5	654.1	4632.2	1600
170	6	654.2	4632.2	1640
171	7	654.1	4632.2	1560
172	8	654.2	4632.1	1680
173	9	654.3	4632.1	1720
174	10	654.4	4632.0	1751
175	11	656.0	4631.3	1740
176	12	654.0	4631.6	1760
177	13	654.0	4631.6	1779
178	14	653.9	4631.6	1720
179	15	655.0	4630.9	1800
180	16	655.0	4630.8	1840
181	17	653.6	4631.5	1680
182	18	653.5	4631.5	1600
183	19	653.5	4631.5	1640
184	20	653.4	4631.6	1560
185	21	653.3	4631.6	1520
186	22	653.2	4631.6	1440
187	23	653.3	4631.6	1480
188	24	653.2	4631.7	1400
189	25	657.3	4629.4	1781
190	26	654.0	4631.0	1840
191	27	654.4	4630.6	1847
192	28	656.0	4629.4	1785
193	29	653.6	4630.7	1760
194	30	653.7	4630.6	1800
195	31	653.6	4630.7	1720
196	32	652.6	4631.4	1640
197	33	652.6	4631.4	1600
198	34	652.7	4631.4	1680
199	35	652.5	4631.5	1560
200	36	652.5	4631.5	1520

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
201	37	652.4	4631.6	1480
202	38	652.3	4631.6	1440
203	39	652.3	4631.6	1400
204	40	655.5	4629.0	1865
205	41	652.4	4631.3	1766
206	42	653.9	4629.8	1883
207	43	653.9	4629.8	1861
208	44	653.5	4630.1	1880
209	45	653.2	4630.1	1840
210	46	653.2	4630.2	1800
211	47	652.0	4631.4	1760
212	48	651.9	4631.4	1680
213	49	651.9	4631.5	1640
214	50	651.9	4631.4	1720
215	51	651.8	4631.5	1600
216	52	651.8	4631.6	1560
217	53	651.7	4631.6	1520
218	54	651.7	4631.7	1480
219	55	651.6	4631.7	1440
220	56	651.6	4631.8	1400
221	57	651.7	4631.5	1800
222	58	651.7	4631.5	1760
223	59	651.7	4631.5	1720
224	60	651.6	4631.5	1680
225	61	651.6	4631.6	1640
226	62	651.5	4631.6	1600
227	63	651.4	4631.7	1560
228	64	651.4	4631.7	1520
229	65	652.0	4630.9	1840
230	66	651.3	4631.7	1480
231	67	652.7	4629.7	1920
232	68	652.1	4630.5	1880
233	69	651.6	4631.3	1760
234	70	651.6	4631.2	1800
235	71	651.6	4631.3	1720
236	72	651.5	4631.4	1600
237	73	651.5	4631.4	1640
238	74	651.5	4631.3	1680
239	75	651.3	4631.6	1520
240	76	651.4	4631.5	1560

**Appendix**  
**Receptor Coordinates for**  
**Warren Station Compliance**

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
241	77	651.3	4631.7	1480
242	78	651.2	4631.8	1400
243	79	651.2	4631.8	1440
244	80	651.2	4631.8	1440
245	81	652.5	4629.9	1880
246	82	652.1	4630.5	1840
247	83	651.6	4631.0	1840
248	84	652.1	4630.1	1880
249	85	652.4	4629.6	1940
250	86	651.3	4631.0	1720
251	87	651.3	4631.1	1640
252	88	651.3	4631.0	1680
253	89	651.1	4631.4	1480
254	90	651.1	4631.5	1440
255	91	651.0	4631.7	1400
256	92	652.8	4627.3	1960
257	93	652.0	4629.1	1920
258	94	651.9	4629.2	1880
259	95	651.6	4630.0	1840
260	96	651.2	4631.1	1600
261	97	651.5	4630.0	1800
262	98	651.3	4630.2	1760
263	99	651.9	4627.4	1930
264	100	650.9	4631.1	1520
265	101	650.9	4631.1	1560
266	102	650.8	4631.1	1560
267	103	650.8	4631.0	1600
268	104	650.8	4631.2	1480
269	105	650.8	4631.4	1400
270	106	650.8	4631.3	1440
271	107	650.8	4631.2	1520
272	108	651.1	4627.3	1920
273	109	650.7	4630.2	1720
274	110	651.0	4627.2	1945
275	111	650.8	4629.3	1760
276	112	650.7	4630.3	1640
277	113	650.7	4630.3	1680
278	114	650.9	4627.6	1880
279	115	650.7	4629.2	1800
280	116	650.7	4629.1	1840

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
281	117	650.7	4629.1	1863
282	118	650.6	4630.4	1520
283	119	650.6	4630.4	1480
284	120	650.6	4630.6	1400
285	121	650.6	4630.3	1560
286	122	650.6	4630.5	1440
287	123	650.6	4630.3	1600
288	124	650.6	4630.2	1640
289	125	650.7	4626.8	1920
290	126	650.2	4629.4	1680
291	127	650.1	4629.3	1720
292	128	650.1	4629.3	1760
293	129	650.1	4629.1	1840
294	130	650.1	4629.2	1800
295	131	650.1	4629.0	1880
296	132	650.0	4628.9	1895
297	133	649.7	4627.5	1920
298	134	649.9	4629.2	1840
299	135	649.8	4629.1	1880
300	136	649.8	4629.4	1800
301	137	649.8	4629.5	1760
302	138	649.5	4628.5	1895
303	139	649.9	4630.7	1720
304	140	649.9	4630.8	1680
305	141	649.9	4630.9	1640
306	142	650.0	4631.6	1440
307	143	650.0	4631.7	1400
308	144	650.0	4631.5	1480
309	145	650.0	4631.5	1520
310	146	650.0	4631.4	1560
311	147	650.0	4631.3	1600
312	148	649.0	4628.7	1880
313	149	649.0	4628.6	1890
314	150	648.9	4628.9	1840
315	151	649.4	4630.3	1741
316	152	648.9	4629.0	1800
317	153	649.9	4631.8	1400
318	154	649.8	4631.7	1480
319	155	649.8	4631.7	1520
320	156	649.9	4631.8	1440

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
321	157	649.7	4631.5	1680
322	158	649.8	4631.6	1560
323	159	649.7	4631.6	1640
324	160	649.7	4631.5	1720
325	161	649.7	4631.5	1680
326	162	649.7	4631.5	1720
327	163	649.8	4631.6	1600
328	164	649.7	4631.4	1760
329	165	648.8	4629.5	1800
330	166	649.7	4631.6	1640
331	167	649.8	4631.6	1600
332	168	648.7	4629.4	1821
333	169	649.8	4631.7	1520
334	170	649.8	4631.7	1560
335	171	649.8	4631.9	1400
336	172	649.8	4631.8	1440
337	173	649.8	4631.8	1480
338	174	647.9	4628.3	1880
339	175	649.7	4631.9	1400
340	176	649.7	4631.9	1440
341	177	647.4	4628.7	1840
342	178	648.3	4630.0	1730
343	179	647.4	4629.0	1920
344	180	647.5	4629.1	1880
345	181	647.5	4629.3	1840
346	182	646.9	4628.6	1935
347	183	647.5	4629.5	1800
348	184	649.5	4632.0	1480
349	185	649.5	4631.9	1520
350	186	649.4	4632.0	1560
351	187	649.4	4631.9	1600
352	188	649.4	4631.9	1640
353	189	649.3	4631.9	1680
354	190	649.3	4631.9	1720
355	191	649.2	4631.8	1760
356	192	649.1	4631.7	1760
357	193	649.3	4631.9	1680
358	194	649.3	4631.9	1720
359	195	649.4	4632.0	1560
360	196	649.3	4632.0	1640

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
361	197	649.3	4632.0	1600
362	198	646.3	4629.2	1800
363	199	649.4	4632.1	1440
364	200	649.4	4632.1	1480
365	201	649.4	4632.0	1520
366	202	649.4	4632.1	1400
367	203	645.5	4629.3	1840
368	204	649.3	4632.2	1400
369	205	649.2	4632.1	1440
370	206	649.2	4632.1	1520
371	207	649.2	4632.1	1480
372	208	649.2	4632.1	1560
373	209	649.0	4632.0	1600
374	210	648.9	4631.9	1640
375	211	648.9	4631.9	1680
376	212	645.3	4629.4	1800
377	213	645.8	4629.9	1785
378	214	645.0	4629.4	1840
379	215	646.2	4630.3	1762
380	216	647.2	4631.2	1720
381	217	647.1	4631.3	1760
382	218	643.6	4629.6	1608
383	219	649.0	4632.3	1400
384	220	649.0	4632.3	1480
385	221	649.0	4632.3	1520
386	222	649.0	4632.3	1440
387	223	646.9	4631.3	1783
388	224	646.1	4630.9	1752
389	225	644.3	4630.5	1800
390	226	644.2	4630.6	1834
391	227	646.6	4631.7	1795
392	228	647.1	4631.9	1720
393	229	647.4	4632.0	1600
394	230	648.7	4632.5	1400
395	231	648.6	4632.5	1560
396	232	648.6	4632.5	1560
397	233	648.5	4632.4	1600
398	234	647.3	4632.1	1640
399	235	647.2	4632.1	1640
400	236	647.1	4632.1	1680

Appendix  
Receptor Coordinates for  
Warren Station Compliance

Sequence Number	Receptor Number	UTM X (km)	UTM Y (km)	Elevation (m)
401	237	647.0	4632.0	1720
402	238	646.8	4632.0	1760
403	239	646.9	4632.0	1760
404	240	644.5	4631.5	1666
405	241	641.7	4630.9	1800
406	242	648.6	4632.6	1440
407	243	641.0	4631.0	1810
408	244	645.9	4632.4	1515
409	245	648.6	4632.8	1520
410	246	648.6	4632.8	1480
411	247	650.6	4634.1	1750
412	248	649.3	4631.9	1720
413	249	650.7	4630.3	1680
414	250	647.1	4632.1	1680
415	251	651.9	4634.4	1776
416	252	651.7	4633.8	1600
417	253	650.1	4634.5	1760